# Sections 1.3 and 1.4

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"Trying to solve a problem before being taught the solution leads to better learning, even when errors are made in the attempt."

- Peter C. Brown, *Make It Stick*

**(1)** Which standardized statistic (standardized sample proportion) gives you the strongest evidence against the null hypothesis for a two-tailed test?

A $z = 1$

B $z = 0$

C $z = -3$

D $z = -1.8$

E $z = 2.9$

**(2)** Identify the TRUE statement below.

A As a $p$-value gets smaller, its corresponding standardized statistic gets closer to zero.

B Large $\hat{p}$ values always correspond with large $p$-values.

C A $p$-value can be negative.

D A standardized statistic can be negative.

E We run tests of significance to determine whether $\pi$ is statistically significant.

**(3)** Suppose that a standardized statistic (standardized sample proportion) for a study is calculated to be $z = -2.45$. Which of the following is the most appropriate interpretation of $z$?

A The observed value of the sample proportion is 2.45 SDs above the hypothesized parameter value.

B The observed value of the sample proportion is 2.45 times the SD of the null distribution.

C The observed value of the sample proportion is 2.45 times the hypothesized parameter value.

D The observed value of the sample proportion is 2.45 SDs away from the hypothesized parameter value.

E The study results are not statistically significant.

# Racquet Spinning

Researchers wanted to investigate whether a spun tennis racquet is equally likely to land with the label facing up or down. **(4)** Does this racquet spinning study call for a one-sided or a two-sided alternative?

A One-sided - there is only one variable: how the label lands

B Two-sided - there are 2 possible outcomes: up or down

C One-sided - the researchers want to know whether the label is more likely to land face up

D Two-sided - the researchers want to know whether the spinning process is fair or biased in either direction

Many football bets include a "point-spread" so that the team that is favored needs to win by more than that amount for a "victory." The point-spreads are designed by professional odds makers with the intention that the probability of the favored team winning by the required amount is 0.50. In a department that has a weekly pool, where members try to predict whether or not the favored team will "beat the spread," Tom correctly predicted the "point-spread victor" in 8 of 12 games (so $\hat{p} = \frac{8}{12} \approx 0.67$. Is this statistically significant evidence that Tom's probability of predicting a point-spread winner is larger than 50%?

**(5)** Shown below are 100 simulated values of $\hat{p}$ assuming $\pi = .5$ and $n = 12$. Which of the following could be the $p$–value for our test of significance, $H_0 : \pi = .5$ against $H_a : \pi > .5$?

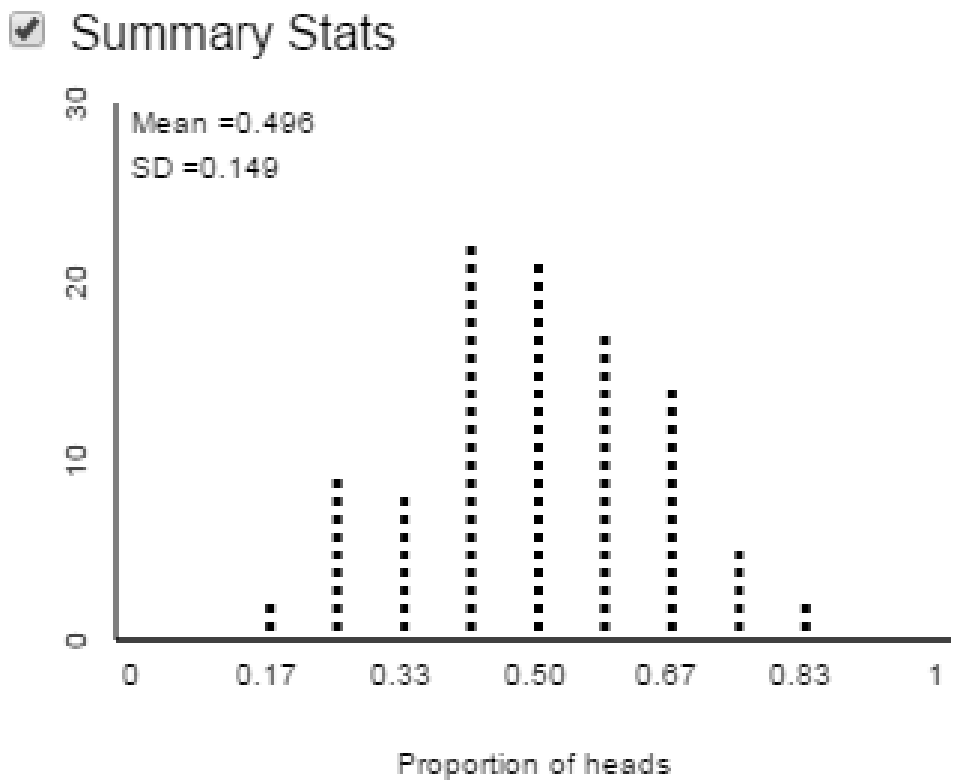
A 0.93

B 0.14

C 0.21

D 0.50

E 0.67



**(6)** Shown below are 100 simulated values of $\hat{p}$ assuming $\pi = .5$ and $n = 12$. The summary statistics give $mean = 0.496$ and $SD = 0.149$. Which of the following is the (approximate) $z$–score for our study statistic $\hat{p} = .667$?

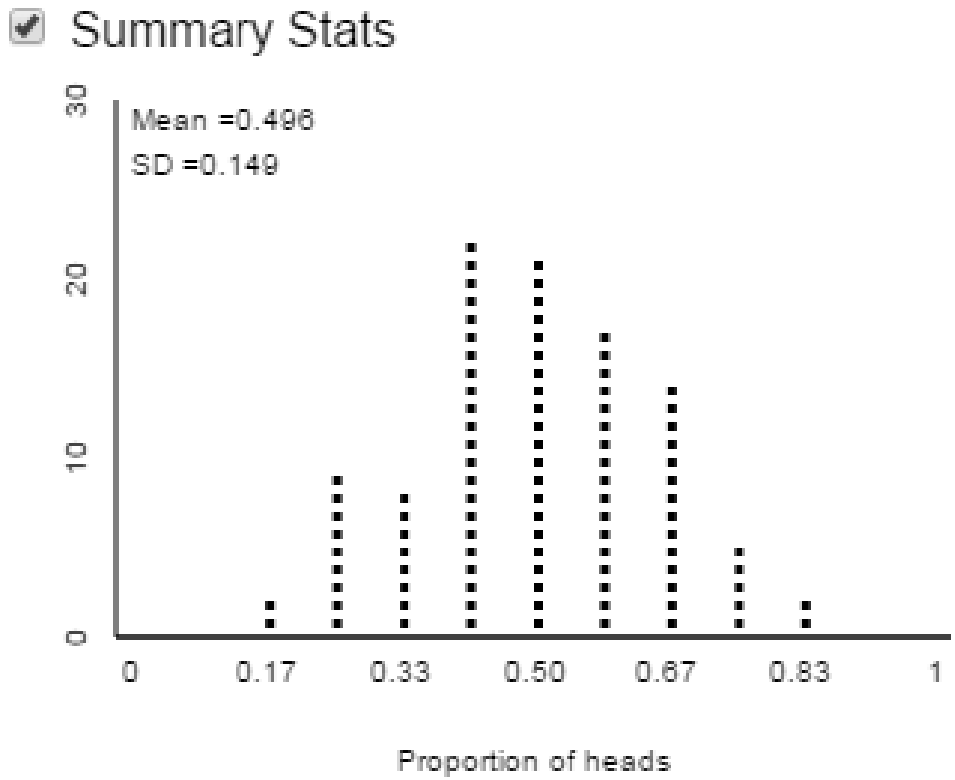
A $z = -2.66$

B $z = 0$

C $z = .027$

D $z = 1.04$

E $z = 1.15$



**(7)** Similar to Exploration 1.2, you decide to test if people will pick tap water less often than expected ($H_0 : \pi = 1/3$ against $H_a : \pi < 1/3$). You ask $n = 30$ people to select the best tasting water (from three choices) and let $X =$ the number who chose tap water. Which of the following results gives the strongest evidence against the null hypothesis?

A $p = .25$

B $\hat{p} = \frac{13}{30}$

C $X = 9$ people chose tap water

D $z = -2.32$

E $z = 3$

**(8)** For Doris and Buzz ($H_0 : \pi = 1/2$ against $H_a : \pi > 1/2$, with $n = 16$ trials), the $z$–score for $\hat{p} = \frac{15}{16}$ is $z = 3.5$. What happens to this $z$–score if the alternative is $H_a : \pi \neq 1/2$?

A It does not change.

B It doubles.

C It gets cut in half.

D You cannot tell.

**(9)** For Doris and Buzz ($H_0 : \pi = 1/2$ against $H_a : \pi > 1/2$, with $n = 16$ trials), each of the $z$–scores on the right corresponds to one of the descriptions on the left. (Remember that the $z$–score for $\hat{p} = 15/16$ is $z = 3.5$.)

1. Buzz got 12 correct.
2. $\hat{p} = \frac{8}{16}$.
3. $p = 0.773$.
4. $p = 0.0013$.

1. $z = -0.5$
2. $z = 0$
3. $z = 2.0$
4. $z = 3.0$

Which description on the left corresponds to $z = 2.0$?

A Description 1

B Description 2

C Description 3

D Description 4

# Key Terms and Ideas to Understand in Section 1.5

- Normal distribution
- Theory-based approach
- Validity conditions for theory-based approach